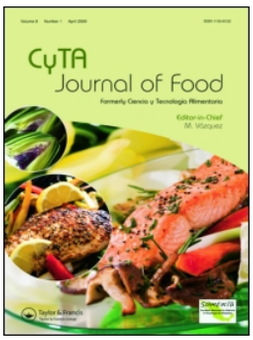

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Application of a seasoning obtained from red grape pomace as a salt replacer for the elaboration of marinated chicken breasts: study of their physical-chemical and sensory properties and microbiological stability

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ABSTRACT

The aim of this work was to elaborate low-salt marinated chicken breasts by the addition of a seasoning obtained from red grape skins. The marinated chicken breasts were prepared by immersion in five different brines: only water (control), 0.5% and 2% of salt, 0.5% of salt and 2% of seasoning and 2% of salt and 2% of seasoning. The marinated breasts were stored under refrigeration and their shelf-life and physical-chemical composition were evaluated. The consumers' acceptance of the product was also evaluated. The breast marinated with a brine of 0.5% of salt and 2% of seasoning had the same shelf-life than those marinated with 2% of salt. From a sensory point of view, the color of the chicken breasts marinated with the seasoning was the less accepted attribute. However, two groups of consumers were found, one more willing to try and accept new products and other more reluctant to try innovative foods.

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KEYWORDS
Seasoning; grape pomace; reduced-salt food; sensory analysis; shelf life

PALABRAS CLAVE
sazonador; hollejo de uva; comida baja en sal; análisis sensorial; vida útil

Aplicación de un sazonador obtenido del hollejo de uva tinta como sustituto de la sal para la elaboración de pechugas de pollo marinadas: estudio de sus propiedades físicas, químicas y sensoriales y su estabilidad microbiológica

RESUMEN

El presente trabajo tuvo como objetivo elaborar pechugas de pollo marinadas con bajo contenido de sal adicionando un sazonado obtenido de la Hollejo de uva tinta. Las pechugas de pollo marinadas se prepararon por inmersión en cinco salmueras diferentes: solo agua (control), 0,5% y 2% de sal, 0,5% de sal y 2% de sazonador y 2% de sal y 2% de sazonador. Una vez marinadas, las pechugas se almacenaron en refrigeración, y se evaluaron su vida útil y su composición fisicoquímica. Asimismo, se valoró la aceptación del producto por parte de los consumidores. La pechuga marinada con salmuera de 0,5% de sal y 2% de sazonador tuvo la misma vida útil que las marinadas con 2% de sal. Desde el punto de vista sensorial, el atributo que registró menor aceptación fue el color de las pechugas de pollo marinadas con el sazonador. Sin embargo, fue posible identificar dos grupos de consumidores, uno con mayor disposición a probar y aceptar nuevos productos y otro más reticente a probar alimentos innovadores.

1. Introduction

The high prevalence of cardiovascular diseases, diabetes and obesity, is motivating dietary changes in the population generating a high demand for healthier foods in the market (Doménech-Asensi, Merola, López-Fernández, Ros-Berruezo, & Frontela-Saseta, 2016; Mildner-Szkudlarz, Siger, Szwengiel, & Bajerska, 2015).

One of the main concerns of the current population is related to salt consumption in foods since it represents the main source of sodium. The high intake of sodium is associated with the development of hypertension, which is a recognized factor for cardiovascular diseases (Doyle & Glass, 2010). A large number of epidemiologic, evolutionary and clinical studies have confirmed that salt intake is an important factor in elevating the blood pressure in humans and in the development of cardiovascular events (Sun Kyu Ha, 2014; Tuomilehto et al., 2001). Different clinical trials had demonstrated that reduced sodium intake to low levels is associated with a reduction in blood pressure w (He & Mac Gregor, 2002). The current World Health Organization (WHO) recommendation on sodium intake for adults is of 2 g sodium/per day (equivalent to 5 g salt/day) (World Health Organization [WHO], 2012); however, the consumption of salt per day of most of the population is between 9 and 12 g/day, twice the maximum intake recommended. In response, many countries have adopted national strategies to reduce the salt intake. It should be taken into account that in Europe, North America and Australia, around 70% of consumed salt comes from processed foods, among which 20% is derived from meat products (Ruusunen & Puolanne, 2005). Salt is one of the main ingredients in the processed meat industry since it affects taste, improve flavor and water and fat binding characteristics which contribute to the formation of stable gel structures within meat products, and increases their shelf-life due to its preservative effect (reduction in water activity) (Doyle & Glass, 2010; Inguglia, Zhang, Tiwari, Kerry, & Burgess, 2017; Ruusunen & Puolanne, 2005). Therefore, due to the importance

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of salt in the formulation of processed meat products, its reduction can negatively affect their sensory, technological and microbiological characteristics. For this reason, in the last years, different approaches and salt replacers have been assayed to obtain low-sodium meat products (Inguglia et al., 2017). Furthermore, the consumers' concerns over the harmful effects of synthetic additives have promoted the search for natural ingredients with anti-microbial and anti-oxidant properties (Mattos, Tonon, Furtado, & Cabral, 2017). A seasoning obtained from wine by-products, in particular in those obtained from red grape skins has been proposed to be used as salt replacers. Red grape skins are rich in polyphenols, dietary fiber polyphenols and potassium (García-Lomillo, González-Sanjosé, Del Pino-García, Rivero-Pérez, & Muñiz-Rodríguez, 2014), compounds which can increase the nutritional value. Furthermore, their high content of potassium and low content of sodium suggest that they can be proposed as seasonings to eliminate or reduce the salt content of processed meat products. In a previous study carried out by García-Lomillo, González-Sanjosé, Del-Pino-García, Rivero-Pérez, and Muñiz-Rodríguez (2017), this seasoning was used as salt replacer in beef patties. The obtained results showed that it was able to reduce the amount of salt without compromising their microbial stability.

In spite of their interest as natural additives, the seasonings obtained from wine and grape by-products can modify some of the sensory properties of the product to which is going to be added such as color (Bekhit et al., 2011; Sáyago-Ayerdi, Brenes, & Goñi, 2009; Walker, Tseng, Cavender, Ross, & Zhao, 2014), texture (Sáyago-Ayerdi et al., 2009; Torri, Piochi, Lavelli, & Monteleone, 2015) and taste (Torri et al., 2015). All these changes can affect the acceptability of the final product. Therefore, before using these products on food matrix, the effect on sensory properties and consumer acceptance should be checked to ensure the success of the product.

Poultry meat is one of the most consumed products in the world and for this reason the aim of this work was to evaluate the effect on the physical-chemical properties and shelf-life of marinated chicken breasts including a seasoning obtained from red grape skins to reduce their level in sodium.

2. Materials and methods

2.1. Raw materials

The chicken breasts and salt were obtained from a local supermarket. The seasoning was obtained from red wine pomace obtained according to the patent developed by González-Sanjosé, García-Lomillo, Del Pino-García, Rivero, and Muñiz-Rodríguez (2015). The proximate and phenolic composition of the seasoning have been published in García-Lomillo et al. (2014) "moisture: 6.8%; total dietary fiber: 48.6%; total lipid: 3.7%; total protein: 14.4%, ash (% of dry matter 14.4% ; potassium: 43.3 mg/g of dry matter; sodium: 1.3 mg/g of dry matter; total phenolic content: 25.9 mg gallic acid/g" (p. 12597).

2.1.1. Marinated breasts preparation

The marinated chicken breasts were prepared by immersion in different brines, with or without seasonings and with different amounts of salt. So, the following assays were carried out.

- Control (C): the brine was only water
- Brine of 0.5% salt (0.5S)
- Brine of 2.0% of salt (2S)
- Brine of 0.5% of salt and 2.0% of seasoning (0.5S2Ss)
- Brine of 2.0% of salt and 2.0% of seasoning (2S2Ss)

About 700 ± 50 g of fresh chicken breast was placed in plastic trays covered with 450 mL of brine. Trays were covered with cling film and stored under refrigerated conditions at 3°C ± 1 for 24 h. After this time the brines were removed, and the drained chicken breasts were placed in new plastic trays, covered again with cling film and stored refrigerated (3°C ± 1) until the end of the study.

Two experiments were carried out on different days and from different raw materials.

2.2. Physical-chemical analysis

Moisture content was evaluated by the difference in the sample weight before and after drying at 105°C to constant weight.

Water activity (a_w) was evaluated using the equipment AquaLab CX-2, and pH was determined with a pH-metro Micro pH2001 (Crison).

Ash content was determined by incineration of the samples at 525°C in a furnace (*J.P.* Selecta, Barcelona, Spain).

Sodium and potassium contents were determined according to the dry ashing method proposed by AOAC, 2000 using flame photometry (Flame Photometer 410, Corning, UK).

2.3. Microbiological analysis

Twenty-five grams of each sample was taken in a random way; then, they were homogenized with 225 mL of buffered peptone water in stomacher bags using laboratory bender (Stomacher 400, Colworth, London UK). Then, decimal serial dilutions from the filtered sample were made using Ringer solution. Total aerobic mesophilic bacteria (TAMB) were determined using pour plates on PCA after incubation at 30°C for 48 h. Lactic acid bacteria (LAB) were enumerated using the Man-Rogosa-Sharpe agar (MRS) agar (Oxoid) after incubation at 30°C for 48 h. Enterobacteriaceae counts were evaluated using a double layer of violet red bile glucose agar (Pronadisa) incubated at 35°C for 24 h. *Pseudomonas sp*. was evaluated using *Pseudomonas* agar oxoid incubated at 24°C for 48 h. *Brochothrix thermosphacta* was evaluated using STAA agar Oxoid incubated at 24°C for 48 h.

All the physical-chemical and microbiological analyses were carried out in triplicate.

2.4. Sensory analysis

Acceptance tests were carried out with 83 usual poultry/chicken consumers (at least once a week), being 67 of them women and 16 men. The age ranged between 17 and 60 years. Before the beginning of the sensory analysis sessions, all the consumers had read the informed consent form for sensory evaluation. Consumers were asked to rate the likeness on color, odor, saltiness, texture and global evaluation of the five type of marinated chicken breasts by using a 5-point hedonic scale (5 = like very much, 4 = like a little, 3 = neither like or dislike, 2 = dislike a little, 1 = dislike very much). Samples were presented one-by-one, following a balanced complete block experimental design. The samples were coded with random three-digit numbers. Consumers could rinse their mouth with water between samples.

According to previous studies of our group, salty notes clearly determined the acceptance and preference of beef patties, and no-salt patties or patties with low-salt content were rejected or received low ratings respect to control patties with 2% of salt (González-Sanjosé, Martín-Nova, Ortega-Heras, & Jaime, 2017). Then, consumers were also enquired about their impressions regarding the salty perception of each product. The five samples under study were presented in a randomly simultaneous way and panelists (83) ranked them from the sample perceived as the least salty to the sample perceived as the saltiest. Data were treated according to the methodology described in UNE-ISO 858721 Norm. Thus, the Friedman test was applied in order to analyze possible significant differences between samples.

A preference test was also carried out. Eighty-three frequent consumers of chicken ranked the five samples of marinated breasts from the "most preferred" to the "less preferred". Samples were presented to consumers in a randomly and simultaneous way. Data were also statistically analyzed according to UNE-ISO 858721 Norm.

2.5. Statistical analysis

Data from physical-chemical and microbiological analyses were statistically analyzed through one-way analysis of variance (ANOVA) and the least significant difference test (LSD) was used to detect differences and to establish which measurements could be considered statistically different. Significance level of $p = 0.05$ was used.

Possible consumer segmentation was checked out through a cluster analysis of the global acceptability data. The wards method was followed using the squared Euclidean distance.

All statistical analyses were carried out using the statistics package Statgraphics Centurion XVI.

3. Results and discussion

3.1. Microbial stability

A usual indicator of the microbial contamination of food is the level of Total Aerobic Mesophilic Bacteria (TAMB). Initial level of TAMB in each batch of marinated breasts ranged between 3.5 and 4.2 log cfu/g (Figure 1). This data showed the usual variability of poultry meat, and similar results were found by García-Lomillo et al. (2014) in beef meat. The TAMB values found in both batches were low, indicating that the raw material was fresh and had no significant microbial load. Regardless of the difference in the initial TAMB counts, the results found in the two experiments were very similar, and samples macerated in brines containing the seasoning had

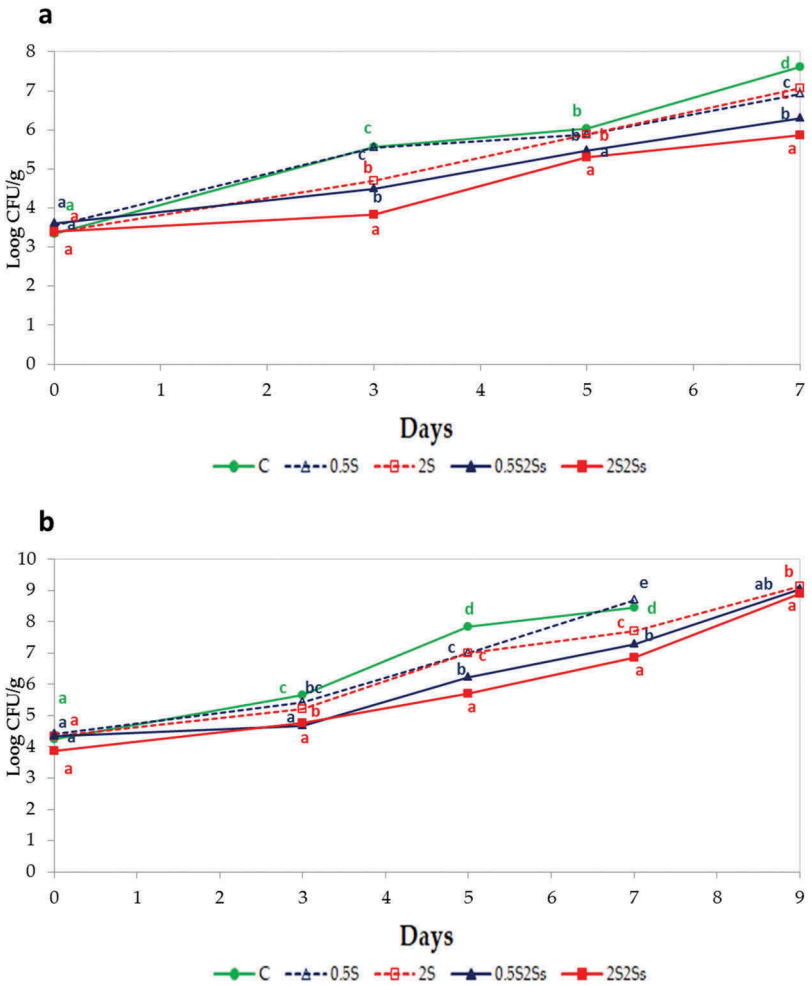

Figure 1. Evolution of the total aerobic mesophilic bacteria counts during storage in two independent experiments (a and b). Points show mean values of three replicates (n = 3) and bars indicate standard deviation at each sampling point. C: Control; 0.5S: 0.5% salt; 2S: 2% of salt; 0.5S2Ss: 0.5% of salt and 2% of seasoning; 2S2Ss: 2% of salt and 2% of seasoning.

Figura 1. Evolución de los recuentos de bacterias mesofílicas aerobias totales durante el almacenamiento en dos experimentos independientes (A y B). Los puntos muestran valores medios de tres réplicas (n = 3) y las barras indican la desviación estándar en cada punto de muestreo. C: control; 0,5S: 0,5% de sal; 2S: 2% de sal; 0,5S2Ss: 0,5% de sal y 2% de sazonador; 2S2Ss: 2% de sal y 2% de sazonador.

the lowest TAMB counts from 3 to 7 days of storage. By contrast, C and 0.5S samples were those with the highest microbial counts. The 2S sample had an intermediate behavior between the samples with and without seasoning, although in the first experiment after 7 days of treatment no statistically significant differences were found between 2S and 0.5S. These results clearly show that lowering salt levels promotes microbial growth and reduces the microbial stability of marinated poultry meat. It is well known that the antimicrobial effect of salt is based on its ability to reduce water activity (a_w), although it has been suggested that salt may also limit oxygen solubility, interfere with cellular enzymes, or force cells to expend energy to exclude sodium ions from the cell, all of which can reduce the growth rate of some organisms (Shelef & Seiter, 2005).

A TAMB count of 7 log cfu/g was established as the upper acceptability limit for fresh chicken meat (Charles, Williams, & Rodrick, 2006; Nychas, Skandamis, Tassou, & Koutsoumanis, 2008). According to this criterion, it is possible to assert that the use of the seasoning increased the shelf-life of the marinated chicken breast, mitigating the negative effect of the reduction of salt levels. Marinated breast with 0.5% salt and seasoning always showed better results (lower counts of TAMB) than breast marinated in brine with 2% salt. Other authors also found a delaying effect against TAMB growth of different products obtained from wine-by products (Bañón, Díaz, Rodríguez, Garrido, & Price, 2007; Lorenzo, Sineiro, Amado, & Franco, 2014; Sagdic, Ozturk, Yilmaz, & Yetim, 2011).

The initial levels of Lactic Acid Bacteria (LAB) in the marinated breast were very similar in the two experiments; however, the growth of these bacteria was faster in the second batch (Figure 2). In the two experiments, the samples marinated in the presence of the seasoning showed a lower growth ratio of LAB than those without the seasoning, regardless of the salt level in the brine. Furthermore, according to the obtained results, the effect of the seasoning seems to be more important than the effect of salt. The observed results of LAB agree with those of TAMB and indicate that the use of the seasoning in the brine allowed to increase the self-life of marinated breasts. Furthermore, obtained results seem to indicate a synergic antimicrobial action of salt and seasoning probably due to the presence of polyphenols (Cueva et al., 2012; Juneja et al., 2013). García-Lomillo et al. (2014) also found the antimicrobial effect of different products obtained from grape pomace against the growth of LAB in beef patties, and Lorenzo et al. (2014) found this effect when seed extracts were added to pork patties.

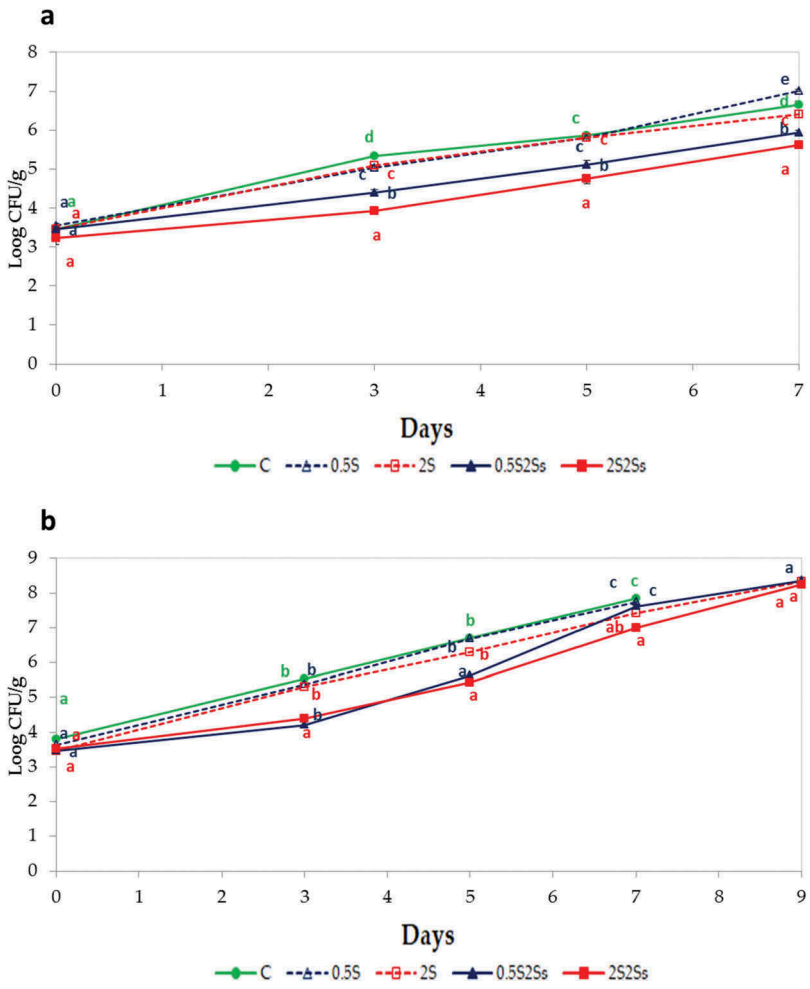

Figure 2. Evolution of the lactic acid bacteria counts during storage in two independent experiments (a and b). Points show mean values of three replicates (n = 3) and bars indicate standard deviation at each sampling point. C: Control; 0.5S: 0.5% salt; 2S: 2% of salt; 0.5S2Ss: 0.5% of salt and 2% of seasoning; 2S2Ss: 2% of salt and 2% of seasoning.

Figura 2. Evolución de los recuentos de bacterias del ácido láctico durante el almacenamiento en dos experimentos independientes (A y B). Los puntos muestran valores medios de tres réplicas (n = 3) y las barras indican la desviación estándar en cada punto de muestreo. C: control; 0,5S: 0,5% de sal; 2S: 2% de sal; 0,5S2Ss: 0,5% de sal y 2% de sazonador; 2S2Ss: 2% de sal y 2% de sazonador.

The counts of *Enterobacteriaceae* found in the initial samples were very similar in both experiments, ranging from 2.3 to 2.8 log cfu/g (Figure 3). However, the effect of salt was not very clear since the results were different in the two experiments. On the other hand, the presence of the seasoning in the brines reduces the growth of *Enterobacteriaceae* in both cases, being higher the reduction in combination with 2% of salt. Similar results were found by García-Lomillo et al. (2014).

Pseudomonas is usually the predominant population in poultry products causing putrid and sulfur odors due to the formation of ethyl esters and sulfur compounds. It is one of the main spoilage microorganisms of chicken meat under refrigeration (Pittard et al., 1982) since they generate off-odors in meats (Sorhaug & Stepaniak, 1997).

The effect of the presence of salt and seasoning in the brine on *Pseudomonas* growth was very similar to the behavior of the other microorganisms discussed above. So, it was detected as an important and positive effect (growth reduction) of the seasoning even when low levels of salt were applied (Figure 4).

The last microorganism evaluated was *Brochothrix thermosphacta*, a gram-positive bacillus that causes deterioration in meat and meat products packaged (Figure 5).

The observed trend in the different studied samples was the same as that of the above microorganisms, although differences among samples were not as important as in the aforementioned microorganisms, especially at 7 days of sampling. However, once again, macerated breast with seasoning showed lower levels of this microorganism even when the level of salt was reduced. Corrales, Han, & Tauscher, () also found a slight activity of grape seed extracts against *B. thermosphacta* when they were incorporated into pea starch films.

3.2. Physical-chemical characteristics of marinated breast

Salt is one of the food ingredients with high capacity to modify a_w, therefore, salt is an usual ingredient in marinated recipes. Obtained results showed a notable effect of salt on the final a_w of marinated chicken breasts (Table 1), with a salt concentration dependent effect. Furthermore, seasoning also had a positive effect on a_w values, and marinated brine formulation with 0.5% of salt and 2% of seasoning showed significantly lower a_w value than the respective control treatment. The sample 2S2Ss showed the lowest values of humidity, which could be related to both, the effect of salt and to the effect of the different properties of the seasoning as well as to the high content of ash and potassium, which could contribute, together with the fiber,

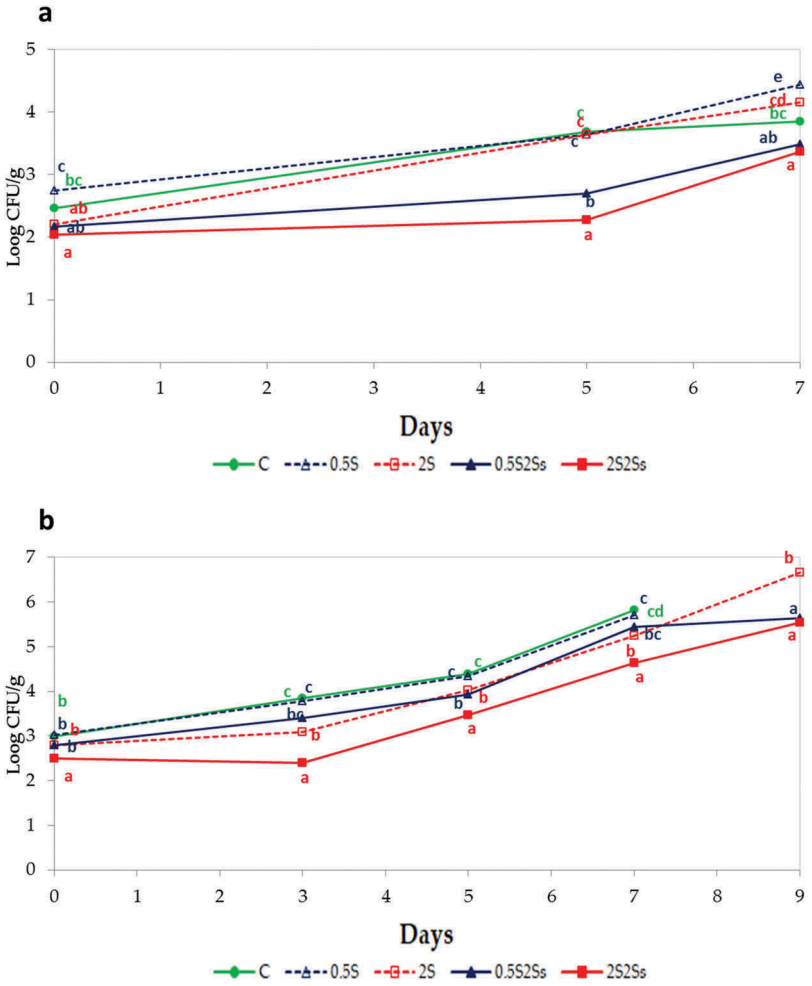

Figure 3. Evolution of the *Enterobacteriaceae*counts during storage in two independent experiments (a and b). Points show mean values of three replicates (n = 3) and bars indicate standard deviation at each sampling point. C: Control; 0.5S: 0.5% salt; 2S: 2% of salt; 0.5S2Ss: 0.5% of salt and 2% of seasoning; 2S2Ss: 2% of salt and 2% of seasoning.

Figura 3. Evolución de los recuentos de *Enterobacteriaceae* durante el almacenamiento en dos experimentos independientes (A y B). Los puntos muestran valores medios de tres réplicas (n = 3) y las barras indican la desviación estándar en cada punto de muestreo. C: control; 0,5S: 0,5% de sal; 2S: 2% de sal; 0,5S2Ss: 0,5% de sal y 2% de sazonador; 2S2Ss: 2% de sal y 2% de sazonador.

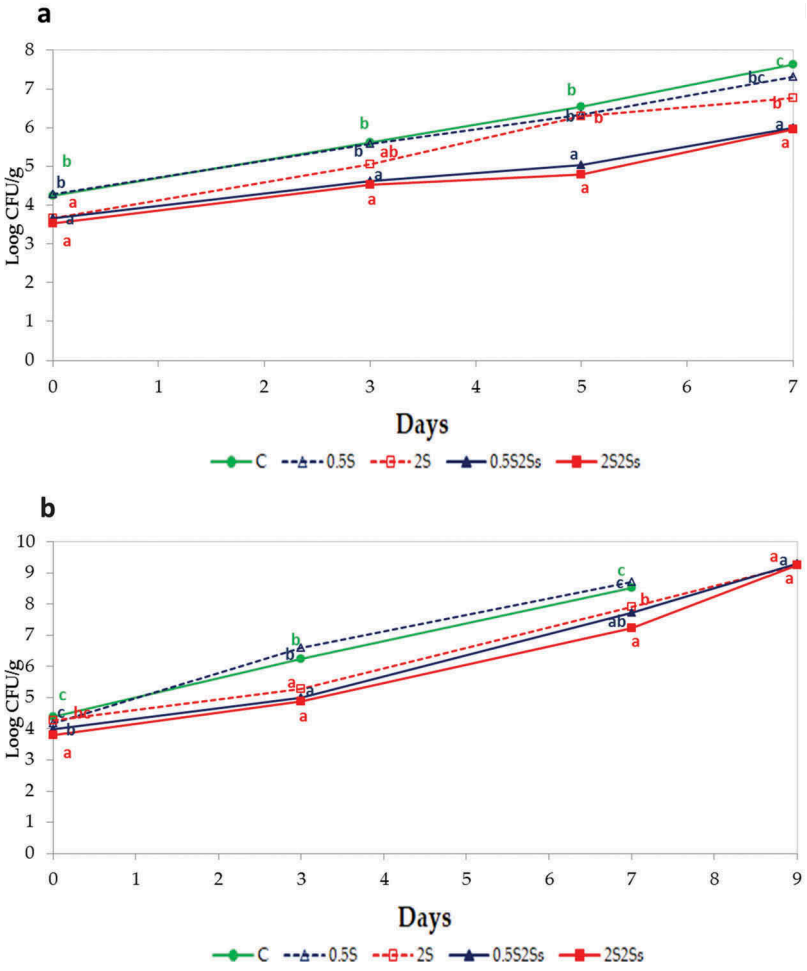

Figure 4. Evolution of the *Pseudomonas* counts during storage in two independent experiments (a and b). Points show mean values of three replicates (n = 3) and bars indicate standard deviation at each sampling point. C: Control; 0.5S: 0.5% salt; 2S: 2% of salt; 0.5S2Ss: 0.5% of salt and 2% of seasoning; 2S2Ss: 2% of salt and 2% of seasoning.

Figura 4. Evolución de los recuentos de *Pseudomonas* durante el almacenamiento en dos experimentos independientes (A y B). Los puntos muestran valores medios de tres réplicas (n = 3) y las barras indican la desviación estándar en cada punto de muestreo. C: control; 0,5S: 0,5% de sal; 2S: 2% de sal; 0,5S2Ss: 0,5% de sal y 2% de sazonador; 2S2Ss: 2% de sal y 2% de sazonador.

to water retention (García-Lomillo et al., 2014). In this sense, statistically significant differences among the levels of ash in the different breasts were detected (Table 1), and the highest ash value was found in the sample with 2% of product and 2% of salt. Furthermore, marinated breasts with the seasoning were those with the highest potassium content and no statistically significant differences were found between them.

According to the levels of salt in the marinated brine, levels of sodium were significantly different among the marinated breast (Table 1). Sodium content of the breasts increased as increased the salt content of the marinated brine, and seasoning did not contribute to the sodium content of the breast, which agrees with previous results indicating very low levels of sodium in the seasoning (García-Lomillo et al., 2014, 2017).

Due to the modification of sodium and potassium levels produced by the different marinated brines, mean values of the Na/K ratio of the different studied chicken breasts were different (Table 1). A remarkable reduction effect of the use of seasoning was detected (close to 50% of reduction dependent on salt levels). Reduction of sodium intake and its combination with increased intakes of potassium have been reported to produce substantial reduction in blood pressure (Doyle & Glass, 2010; Filippini, Violi, D'Amico, & Vicenti, 2017).

The use of brines with 2% of salt lowered the pH of the marinated breast (Table 1). It is known that salt added to the meat system can promote protein solubilization that could induce a pH evolution in meat products throughout the salting process (Liu, Pu, Sun, Wang, & Zeng, 2014).

3.3. Sensory analysis

3.3.1. Acceptance test

A liking test was performed in order to estimate the consumer´s acceptability of the different breast products. Different attributes related to the sensory properties of the product were tested: color, odor, saltiness, texture and overall linking. The obtained results showed that no statistically significant differences were found in odor, and regarding saltiness all the samples with less salt than the control presented lower scores than it (Table 2). Sáyago-Ayerdi et al. (2009) also did not find difference in odor in hamburgers elaborated with different concentrations of dietary fiber obtained from red grape pomace.

However, color, texture and overall linking in the breasts marinated with seasoning-containing brine were given lower scores than the chicken breasts marinated without it (Table 2). This could be due to the fact that consumers were not familiarized with chicken breasts with a significant modification of the

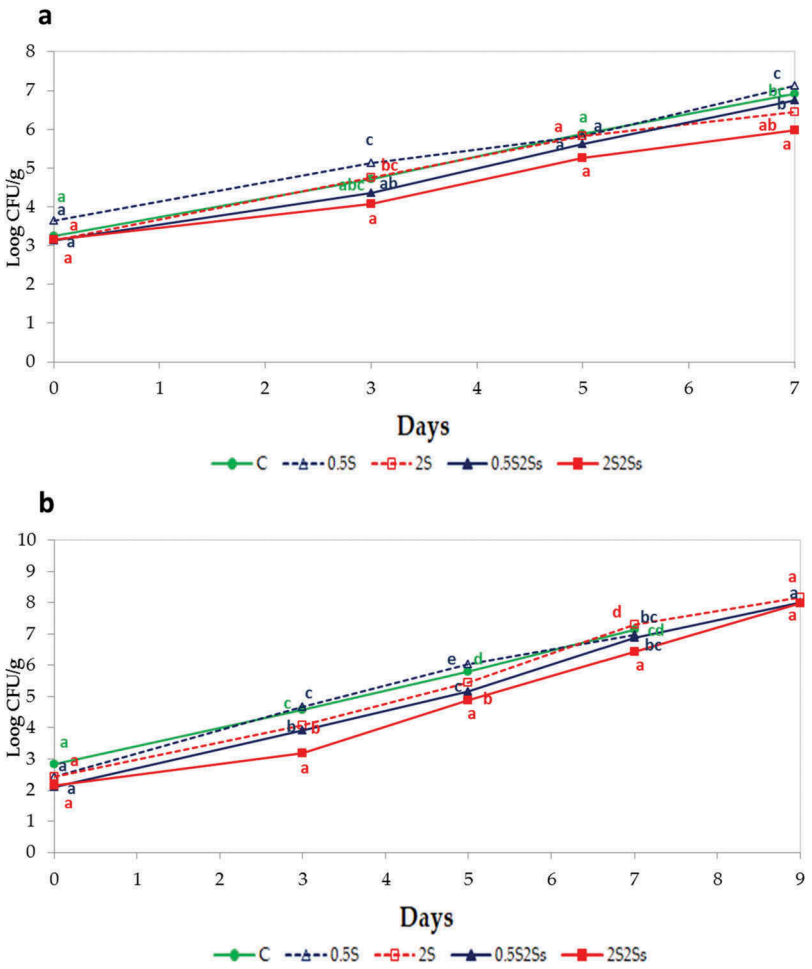

Figure 5. Evolution of the *Brochothrix thermosphacta* counts during storage in two independent experiments (a and). Points show mean values of three replicates (n = 3) and bars indicate standard deviation at each sampling point. C: Control; 0.5S: 0.5% salt; 2S: 2% of salt; 0.5S2Ss: 0.5% of salt and 2% of seasoning; 2S2Ss: 2% of salt and 2% of seasoning.

Figura 5. Evolución de los recuentos de *Brochothrix thermosphacta* durante el almacenamiento en dos experimentos independientes (A y B). Los puntos muestran valores medios de tres réplicas (n = 3) y las barras indican la desviación estándar en cada punto de muestreo. C: control; 0,5S: 0,5% de sal; 2S: 2% de sal; 0,5S2Ss: 0,5% de sal y 2% de sazonador; 2S2Ss: 2% de sal y 2% de sazonador.

Table 1. Physical-chemical composition of the different samples. Data are the mean value of three replicates (n = 3). 0.5S: 0.5% salt; 2S: 2% of salt; 0.5S2Ss: 0.5% of salt and 2% of seasoning; 2S2Ss: 2% of salt and 2% of seasoning.

Tabla 1. Composición físico-química de las diferentes muestras. Los datos representan el valor medio de tres réplicas (n = 3). 0,5S: 0,5% de sal; 2S: 2% de sal; 0,5S2Ss: 0,5% de sal y 2% de sazonador; 2S2Ss: 2% de sal y 2% de sazonador.

	Ashes (%)		K (g/kg breast chicken)		Na (g/kg breast chicken)		Na/K	pH		aw		Humidity (%)	
Control	0.77 ± 0.01	a	2.11 ± 0.12	a	0.513 ± 0.002	a	0.243	6.03 ± 0.02	b	0.996 ± 0.001	d	77.6 ± 0.8	b
0.5S	0.93 ± 0.05	b	2.13 ± 0.04	a	0.235 ± 0.072	c	0.118	6.03 ± 0.07	b	0.992 ± 0.001	c	77.5 ± 1.5	b
2S	2.21 ± 0.15	d	2.18 ± 0.08	a	0.619 ± 0.127	e	0.283	5.99 ± 0.16	a	0.985 ± 0.001	a	77.5 ± 1.2	b
0.5S2Ss	1.96 ± 0.01	c	3.66 ± 0.06	b	0.191 ± 0.161	b	0.052	6.10 ± 0.07	b	0.990 ± 0.001	b	77.1 ± 0.7	b
2S2Ss	2.91 ± 0.04	e	3.76 ± 0.04	b	0.583 ± 0.141	d	0.155	5.88 ± 0.17	a	0.984 ± 0.001	a	75.3 ± 0.5	a

Values in the same column and with the same letter mean that there are no statistically significant differences between the samples for p-value ≤ 0.05.

Los valores en la misma columna y con la misma letra indican que no hay diferencias estadísticamente significativas entre las muestras para el valor $p \leq 0,05$.

color. The level of familiarity for a food strongly influences its acceptability by the consumer and a way to increase the acceptability of the product is a repeated exposure to the modified food (Wardle & Cooke, 2008). Furthermore, it is well known that color plays an important role in the perception of other sensory properties such as odor, flavor and taste (Shankar, Levitan, & Spence, 2010; Zampini, Sanabria, Phillips, & Spence, 2007); therefore, an unexpected change in the appearance of the breast could negatively affect the acceptability of other attributes such as texture and overall liking. These results agree with those found by Lavelli, Sri Harsha, Torri, and Zeppa (2014) in tomato purees fortified with grape products. The authors explained this effect taking into account that consumers were familiar with the unfortified samples (commercially available regular tomato purees), but they had not been previously exposed to the fortified samples.

Regarding the overall liking, average ratings of the breast marinated with the seasoning were 3.1 and 3.3, which correspond to the central value of the scale (neither like nor dislike). These results seem to indicate that color was the most influencing parameter on the global acceptability of the breast marinated with the seasoning. Similar results were found by Sáyago-Ayerdi et al. (2009) and Özvural and Vural (2011) in chicken hamburgers and Frankfurt sausages elaborated from dietary fiber obtained from red grape pomace and seed flour,

Table 2. Acceptability of the different studied attribute. 0.5S: 0.5% salt; 2S: 2% of salt; 0.5S2Ss: 0.5% of salt and 2% of seasoning; 2S2Ss: 2% of salt and 2% of seasoning.

Tabla 2. Aceptabilidad de los diferentes atributos estudiados. 0,5S: 0,5% de sal; 2S: 2% de sal; 0,5S2Ss: 0,5% de sal y 2% de sazonador; 2S2Ss: 2% de sal y 2% de sazonador.

		Color		Odor		Saltiness		Texture		Overall liking	
Global data	Control	3.36 ± 0.94	b	3.49 ± 0.72	a	2.54 ± 1.03	a	2.81 ± 0.91	a	2.71 ± 0.88	a
	0.5S	3.41 ± 0.95	b	3.49 ± 0.85	a	2.98 ± 1.00	b	3.19 ± 0.95	b	3.18 ± 0.97	b
	2S	3.81 ± 0.98	c	3.71 ± 0.66	a	3.55 ± 1.05	c	3.76 ± 0.92	d	3.76 ± 1.02	c
	0.5S2Ss	3.12 ± 1.06	ab	3.46 ± 0.85	a	3.02 ± 0.92	b	3.17 ± 1.02	bc	3.17 ± 1.01	b
	2S2Ss	2.99 ± 1.13	a	3.50 ± 0.79	a	3.34 ± 0.98	c	3.34 ± 1.01	cd	3.34 ± 1.23	b
Cluster 1	Control	3.35 ± 0.91	a	3.52 ± 0.77	a	2.55 ± 0.90	a	2.85 ± 0.93	a	2.72 ± 0.81	a
	0.5S	3.35 ± 0.91	a	3.46 ± 0.95	a	3.00 ± 1.01	b	3.22 ± 0.96	b	3.14 ± 0.96	b
	2S	3.89 ± 0.92	b	3.74 ± 0.68	a	3.61 ± 1.04	cd	3.89 ± 0.83	c	3.85 ± 0.96	c
	0.5S2Ss	3.26 ± 0.99	a	3.65 ± 0.83	a	3.32 ± 0.84	bc	3.57 ± 0.93	c	3.61 ± 0.81	c
	2S2Ss	3.31 ± 1.08	a	3.74 ± 0.71	a	3.69 ± 0.80	d	3.80 ± 0.91	c	3.93 ± 0.84	c
Cluster 2	Control	3.80 ± 1.01	c	3.43 ± 0.63	bc	2.61 ± 1.17	a	2.82 ± 0.71	a	2.79 ± 0.81	a
	0.5S	3.52 ± 1.02	c	3.54 ± 0.63	c	3.04 ± 0.84	a	3.25 ± 0.74	bc	3.36 ± 0.96	c
	2S	3.66 ± 1.08	c	3.64 ± 0.62	c	3.57 ± 0.88	b	3.61 ± 0.77	c	3.71 ± 0.96	c
	0.5S2Ss	2.86 ± 1.16	b	3.10 ± 0.79	ab	2.57 ± 0.69	a	3.04 ± 0.91	ab	2.43 ± 0.81	ab
	2S2Ss	2.38 ± 0.98	a	3.04 ± 0.74	a	2.79 ± 0.83	a	3.04 ± 0.79	ab	2.32 ± 0.84	a

Values in the same column and with the same letter mean that there are no statistically significant differences between the samples for p-value ≤ 0.05.

Los valores en la misma columna y con la misma letra indican que no hay diferencias estadísticamente significativas entre las muestras para el valor $p \leq 0,05$.

respectively. This fact could affect the overall acceptance of the product since previous studies have shown that consumers' expectations of meat quality are strongly related to the product's appearance (Haugaard, Hansen, Jensen, & Grunert, 2014; Verbeke et al., 2005).

It is well known that acceptability is a subjective factor which is variable between consumers and usually different consumer groups with different acceptance and preference criteria can be detected. This fact was tested through cluster analysis. Thus, the overall liking data obtained from the 83 consumers were submitted to cluster analysis in order to detect a potential consumers' segmentation. According to the results obtained, two groups of consumers were detected: the first consist of 54 consumers (65%) and the second one was formed by 29 consumers (35%). The consumers belonging to the first cluster gave similar scores to the chicken breasts marinated with the seasoning and to the control with 2% of salt (Table 2). In this group, no statistically significant differences were found among the different samples evaluated regarding the odor. The color was the only parameter in which the control breast with 2% of salt had higher scores than the other samples. However, for the consumers grouped in the second cluster, the marinated breasts with the product had fewer acceptances than the controls with salt, for all the attributes evaluated (Table 2). This result seems to indicate that a significant percentage of consumers have certain level of resistance to try or accept new or unfamiliar food products. Many previous studies have confirmed the importance of familiarity as a driver food products usage, and that some consumers can express certain level of resistance to adopt a new or unfamiliar food product (Barrera & Sánchez, 2012; De-Barcellos et al., 2010; Hoek et al., 2011). This aversion to try new foods is called food neophobia. Furthermore, no gender or age effect was found for the acceptance or aversion to new foods.

3.3.2. Possible incidence of salty sensation on acceptability

Among the taste sensation, salty taste of meat products is very important to consumers. So, it was considered of interest to check how consumers perceived the intensity of the salty perception of each product. The values obtained for the sum of ordinations (R) were: $R_{control}$ = 122; $R_{0.5S}$ = 196; R_{2S} = 336; $R_{0.5S2Ss}$ = 248; R_{2S2Ss} = 348. According to UNE-ISO 8587 Norme, the $F_{test\ calculated}$ was 187 which allowed to conclude that there were statistically significant differences among the five samples (α = 0.05, Norme ISO 8587). The Minimum Significative Difference (MSD), calculated for α = 0.05 and z = 1.96, was 40. Then, the control sample was clearly different from the other samples, and in general, the lower the amount of salt in the sample, the lower saltiness was indicated. It is interesting to point out that the sample with 0.5% of salt and 2% of seasoning was perceived as saltier than the sample with 0.5% of salt, indicating that the presence of the seasoning enhanced the salty perception of the marinated chicken breasts in brine with low levels of salt. This fact seems to be clearly perceived by consumers of cluster one, who evaluated very similarly the acceptability of the salty sensation of this sample to that of 2% of salt. However, the consumers of the second cluster scored lower the saltiness of the sample with seasoning than that of the samples with salt, fact that clearly shows the negative effect of unexpected appearance on the evaluation of other sensory properties.

3.3.3. Preference test

Consumers were asked to order the samples from the most preferred to the least preferred. In this way, the lower the R value, the more preferred the sample. The values obtained for the sum of ordinations (R) were: $R_{control}$ = 315; $R_{0.5S}$ = 272; R_{2S} = 173; R_{2S05Ss} = 273; $R_{2S2Ss=}$222. The value of F_{test} calculated was 82 and again statistically significant differences were found among the five samples (MSD was 40). According to the obtained results, the least preferred sample was the control without salt and seasoning, followed by the control sample with 0.5% of salt and seasoning and with only 0.5% of salt, which indicated the strong effect of salty sensations on the preference. The most preferred sample was the control one with 2% of salt with an important difference with the following sample that with 2% of salt and 2% of seasoning. These results seem to indicate that, when the main sensation that determines the consumer preference, in this case the saltiness, is similar, other parameters, probably, those related with the appearance, acquired the main role to determine the preference.

4. Conclusions

The obtained results showed the possibility to launch marinated chicken breast with lower content of salt (0.5%), without compromising the shelf-life of the product or even increasing it. Furthermore, the reduction of sodium levels and the incorporation of potassium, which results in a reduction of the Na/K ratio, could be considered an improvement of the nutritional properties of this food.

However, the new-marinated chicken breast will not be well accepted by all the consumers, being a product only well positioned among consumers willing to accept new products.

Therefore, new research should be carried out in order to know the sources of rejection of the neophobic group as well as to identify the target consumers more interested in these innovative products in order to establish the communication and the most appropriate positioning strategies in each case. It would be also interesting to know if the knowledge of the healthy benefits of the marinated breast with the seasoning could change the acceptance of the population belonging to the neophobic group.

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